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International Discussion on Hydrogen Energy and Applications

The Hydrosol (r)evolution – From an idea to a large scale plant

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Introduction

Solar Hydrogen production via two-step water splitting process (Fig. 1), performed on monolithic honeycomb reactors capable of achieving high temperatures when irradiated with solar energy and coated with active redox pair materials capable of performing water dissociation and being at the same time reversibly reducible and oxidizable, so that complete operation (water splitting and redox material regeneration) can be achieved on a single solar monolithic energy converter.

$$MO_{reduced} + H_2O \rightarrow MO_{oxidized} + H_2$$

$$MO_{oxidized} \rightarrow MO_{reduced} + O_2$$

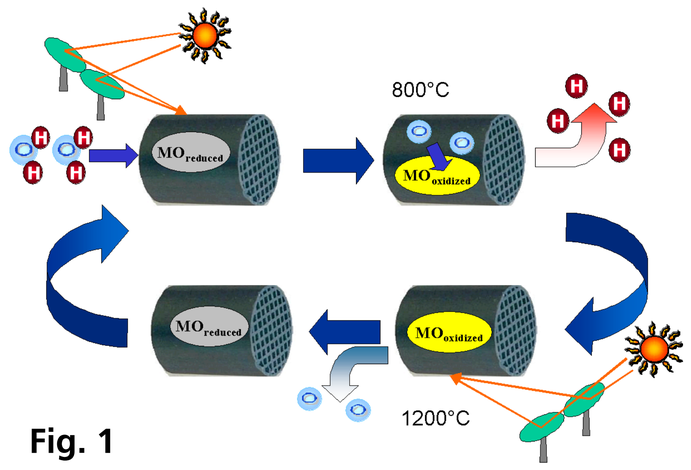

Fig. 1

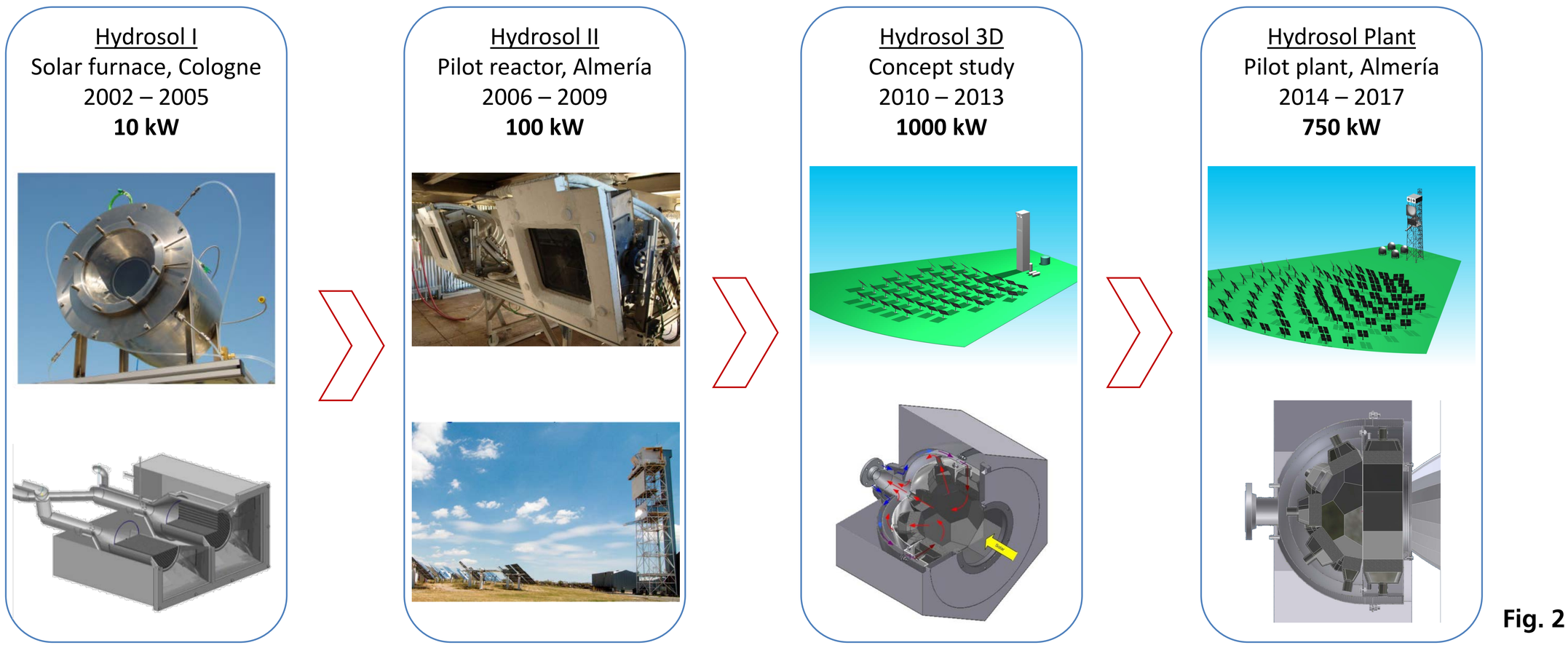

Fig. 2

The Hydrosol evolution (Fig. 2)

Starting the Hydrosol project, a batch reactor was developed to proof the concept's feasibility, at the DLR solar furnace, in Cologne, Germany. After verifying this, a quasi-continuous reactor, so-called conti-reactor, was designed, constructed and tested, again in the solar furnace.

In Hydrosol II, the conti-reactor had to be scaled up from 10 kW_{th} to 100 kW_{th} and was successfully tested at the Plataforma Solar de Almería (PSA), Spain.

Hydrosol 3D had the aim to provide a case study for a 1 MW facility at a greenfield site. Thus, a cavity design with 7 reactor modules per step was developed and designed. The continuous process from Hydrosol II was kept and improved to a modular design. This modular construction allows an easy adapt of plant size.

In Hydrosol plant, the fourth project, the case-study of Hydrosol 3D shall be improved and afterwards built in Almeria at the PSA. The total thermal power, for both reaction steps, will be 750 kW_{th}. The reactor construction is one of the main parts, as well as the total plant design and controlling the whole process.

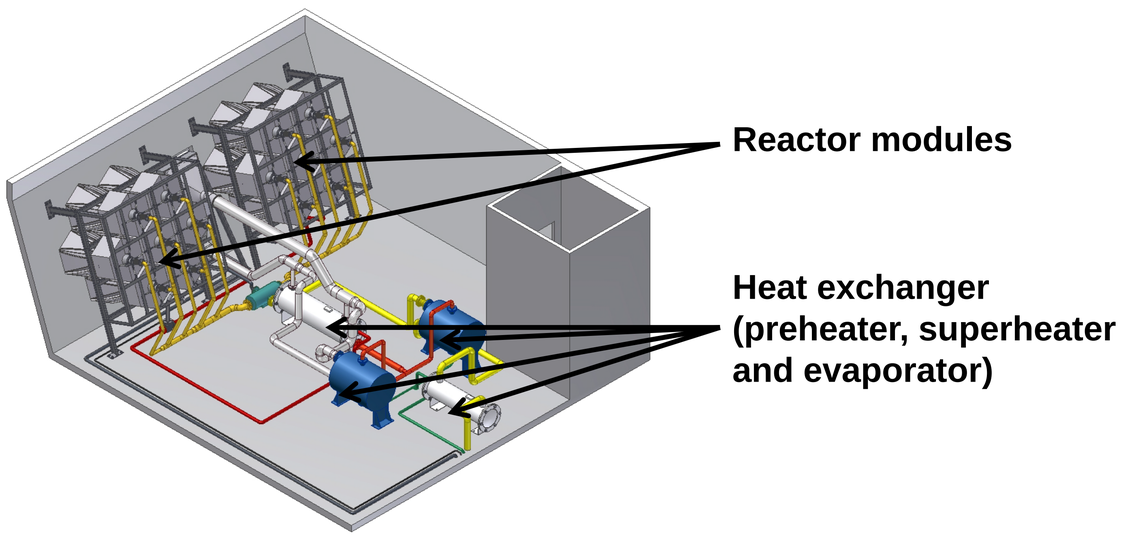

Fig. 3

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